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CABLE HOUND™

CABLE LOCATOR OPERATING AND SERVICE MANUAL

MetroTel

56-0005

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1. GENERAL

1.01 This manual has been prepared to serve as a guide for operating and servicing the Cable Hound™ cable locator.

1.02 Included in this manual is a general description, operating instructions, maintenance instructions, repair procedures, and a complete replacement parts list.

1.03 Operating personnel should familiarize themselves with the information contained in this manual before operating the unit. If operated as described, the cable locator will prove to be dependable and time saving.

1.10 Description

1.11 The Cable Hound cable locator (Figure 1) is designed to locate and determine the depth of buried cable. The unit consists of a Transmitter, Receiver, Tone Probe, Ground Rod, and Carrying Case. Two types of carrying cases are available:

Metro Tel Number	Former Number	Description	Dimensions Height	Length	Width	Weight
99-0116	71-620-00	Cable Hound in Wood Case	4.13" (105mm	11.50" 292mm	5.50" 140mm	4.5 lbs. 2.27 KG)
99-0117	71-620-10	Cable Hound in Plastic Case	3.62" (92mm	13.75" 349mm	10.12" 257mm	4.5 lbs. 2.27 KG)

Weights are less batteries

DISCONTINUED

1.12 Transmitter — The Transmitter (Figure 2) is of solid-state design and is held in the Carrying Case with two retainer tabs. The unit is equipped with a control switch that selects either steady or warble tone for transmission, a battery meter which indicates condition of internal batteries, two clip leads for connecting unit to ground rod and cable shield, and a power jack and disconnect plug. Power for the unit is supplied by eight "C" size batteries.

NOTE: The Transmitter is shipped less batteries. To install batteries, refer to paragraph 4.02.

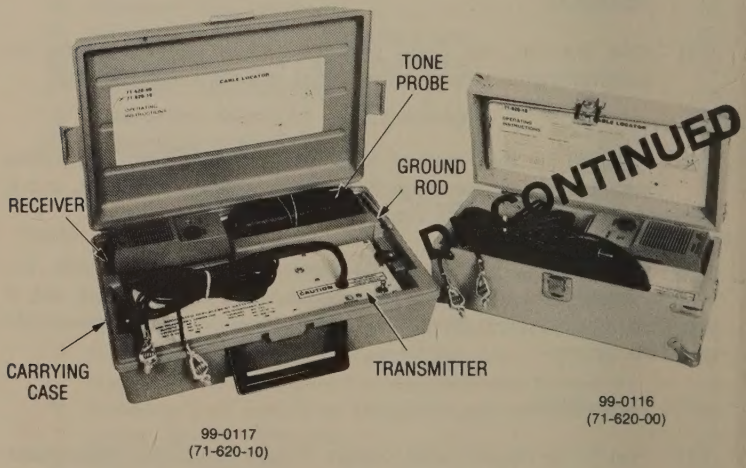


Figure 1. Cable Hound Cable Locator

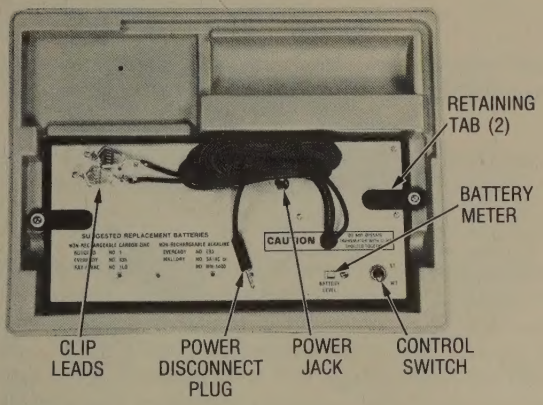


Figure 2. Transmitter

1.13 Receiver — The Receiver (Figure 3) is of solid-state design and is encased in a durable plastic housing. It is equipped with a speaker to reproduce the detected tone for locating the cable, volume control, battery meter to determine internal battery conditions, a jack, and an on-off switch.

NOTE: The Receiver is shipped less battery. To install battery, refer to paragraph 4.03.

1.14 Tone Probe — The Tone Probe (Figure 4) is encased in molded synthetic rubber and acts as a directional antenna to pick up the transmitted tone. The unit is equipped with a bubble level set at a 45° angle which enables the cable depth to be accurately determined (refer to paragraph 2.06). The Tone Probe is connected to the Receiver by a plug-ended cable.

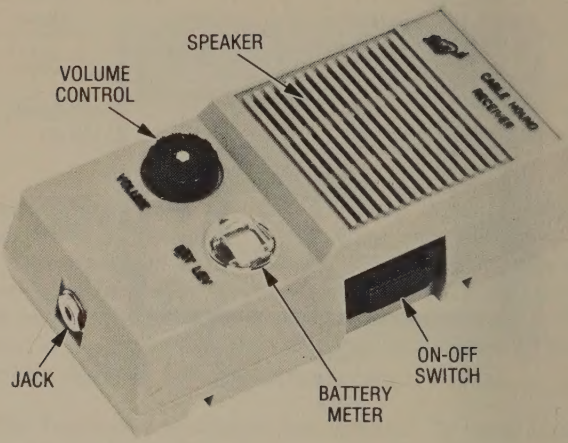


Figure 3. Receiver

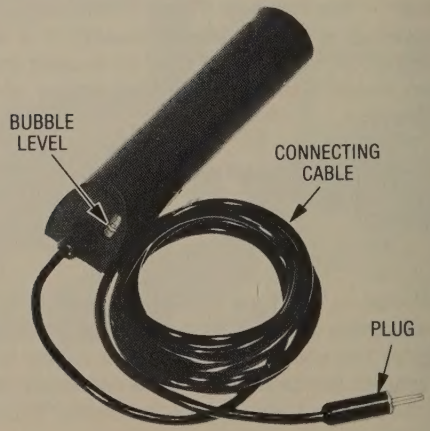


Figure 4. Tone Probe

2. OPERATING INSTRUCTIONS

2.01 Prior to actually using the cable locator, read the following instructions to familiarize yourself with the operating procedures.

NOTE: For quick reference, condensed instructions are also contained on the label located on the inside cover of the case.

2.02 Transmitter — Two alternate connection procedures are illustrated for the Transmitter (Figure 5). The normal connection procedure usually provides adequate output and requires minimum setup time. If the 2700Hz signal strength is low, a longer ground rod may need to be substituted for that supplied with the cable locator. Often the alternate connection procedure will provide increased output in areas where the normal connection procedure proves inadequate.

2.03 Normal Connection Procedure

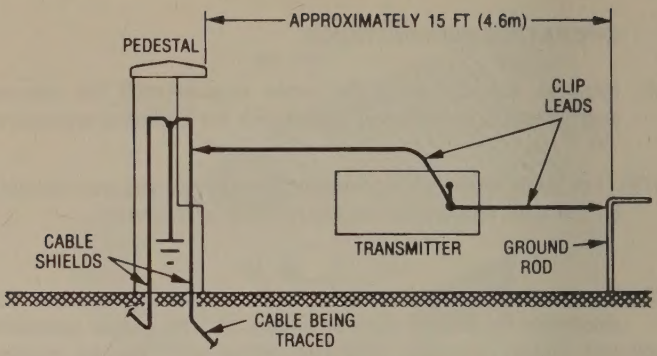
Step 1. Before using Transmitter, check battery meter for condition of internal batteries. Replace the eight "C" size batteries if meter indicates in the RED area. (Refer to paragraph 4.02, Battery Replacement — Transmitter.)

Step 2. Connect either clip lead from transmitter to the cable shield at pedestal.

Step 3. Determine general cable direction and insert ground rod into the ground approximately 15 feet (4.6m) from pedestal at right angles to the cable route.

Step 4. Connect remaining transmitter clip lead to ground rod.

Step 5. Turn Transmitter on by inserting power disconnect plug into power jack. Set control switch on either ST (steady tone) position or WT (warble tone) position.



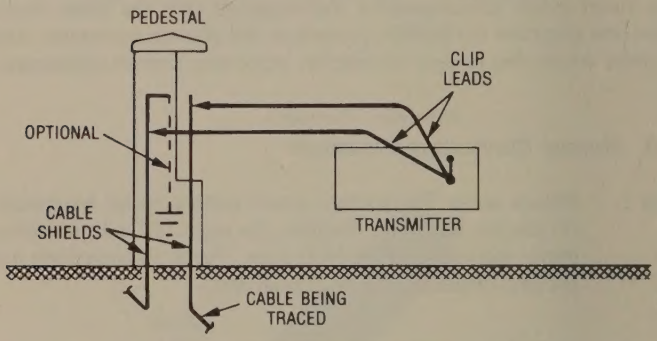


Figure 5. Connecting Transmitter

2.04 Alternate Connection Procedure

Step 1. Before using Transmitter, check battery meter for condition of internal batteries. Replace the eight "C" size batteries if meter indicates in the RED area. (Refer to paragraph 4.02, Battery Replacement — Transmitter.)

Step 2. Disconnect one (or both) cable shield(s) from pedestal ground lug.

Step 3. Break shield continuity to obtain two shield leads if step 2 has not already accomplished this.

Step 4. Connect one Transmitter clip lead to each shield.

Step 5. Turn Transmitter on by inserting power disconnect plug into power jack. Set control switch on either ST (steady tone) position or WT (warble tone) position.

2.05 Receiver Unit

Step 1. Before using Receiver, check battery meter for condition of the internal battery. Replace the 9-volt battery if meter indicates in the RED area. (Refer to paragraph 4.03, Battery Replacement — Receiver.)

Step 2. Plug Tone Probe into Receiver jack.

Step 3. Press ON-OFF switch and set volume control at medium volume. Adjust volume control as required during test.

Step 4. Suspend Tone Probe so it is two to three inches (51 to 76mm) above the ground near the pedestal.

Step 5. A tone should be picked up at once. If not, check transmitter leads to cable shield(s) and/or ground rod to ensure good contact is being made.

2.06 Cable Locating Procedure

2.07 Using the Tone Probe is much like using a flashlight. Whenever the probe is pointed directly at a cable connected to the transmitter, the tone will diminish in volume. Thus, when the cable route is being traced, it is only necessary to walk near the cable route, using the Tone Probe to prevent straying too far from its location. When the

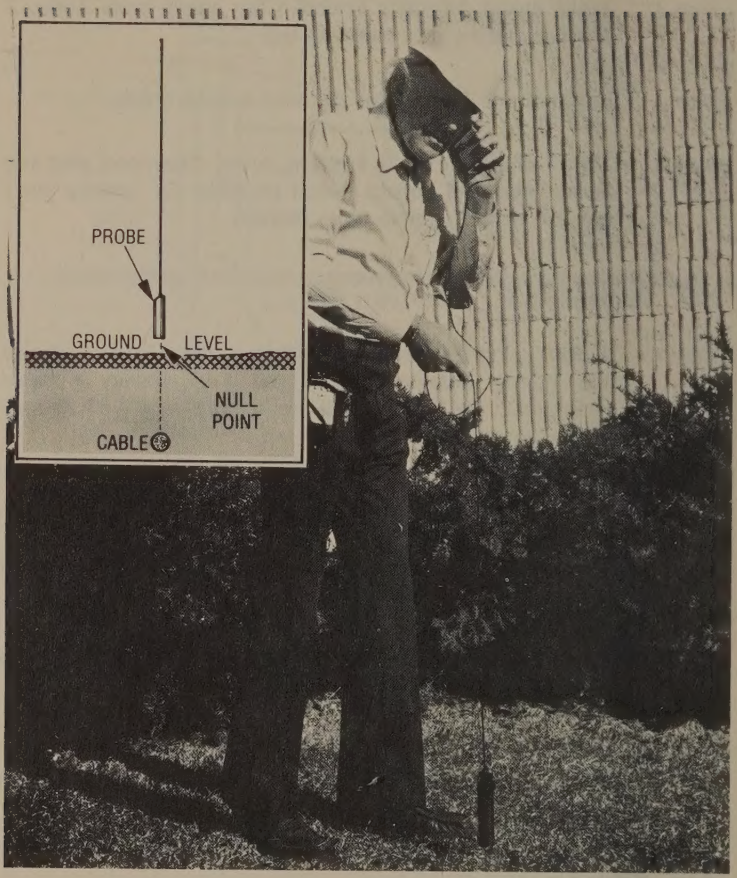


Figure 6. Locating Cable

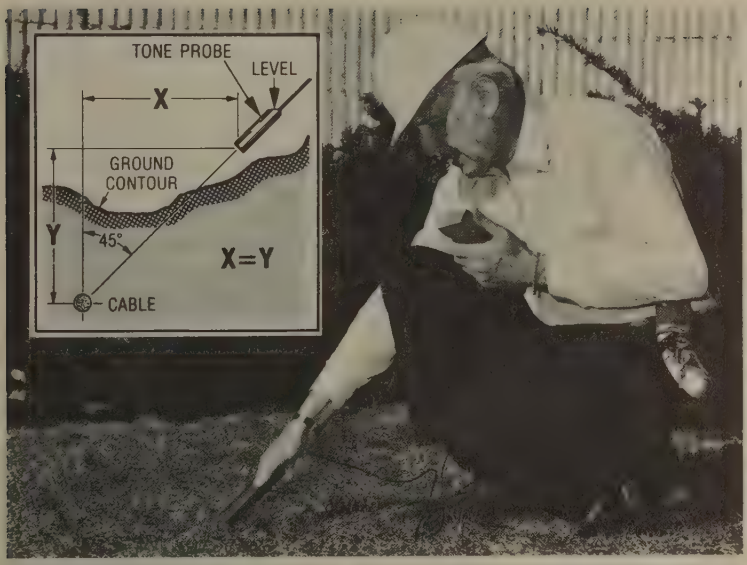


Figure 7. Determining Cable Depth

exact cable location and depth are required, utilize the following procedure for more accurate information.

Step 1. Suspend the probe (Figure 6) like a plumb bob near the suspected cable location. Move the probe back and forth at right angles to the cable route until the suspended probe is in a null position (minimum audible tone). Mark this position. The cable is directly beneath the mark.

Step 2. Hold the Tone Probe at a 45° angle (use the bubble level) near ground level (see Figure 7). Move away from the original null position at right angles to the cable route. When the tone nulls out again, the distance between the original null and the new null position is the same as the cable depth. The shape of the terrain must be taken into account in making this measurement.

3. THEORY OF OPERATION

3.01 The Cable Hound cable locator produces a 2700Hz magnetic field around cables connected to the Transmitter. The field is external to the shield and concentric to the cable. The Tone Probe used with the Receiver has several thousand turns of wire on a ferrite core. When oriented in any direction except directly pointed at the cable, the ferrite core conducts the magnetic field through the coil of wire, causing a 2700Hz AC voltage to be induced into the wire. The 2700Hz voltage is amplified by a tuned amplifier and coupled to a loudspeaker. The tone heard by the operator varies in amplitude depending on the orientation of the probe to the magnetic field. The tone level drops to zero when the probe is pointed directly at the cable.

3.02 Transmitter — The Transmitter (Figure 8) is powered by a 12VDC battery made up of eight "C" cells. The unit is switched on by inserting a shorted miniature plug into a jack. The battery voltage is monitored by an expanded scale voltmeter. Power from the 12VDC battery is applied to a Power Amplifier, 2700Hz Oscillator and a Warble Oscillator. In operation, the 2700Hz Oscillator output is amplified by the Power Amplifier and connected to the cable shield and ground. The 2700Hz Oscillator can be set to operate continuously or produce a pulsed tone by the position of toggle switch S1. The pulsed tone results from switching on and off the 2700Hz Oscillator at a rate defined by the Warble Oscillator.

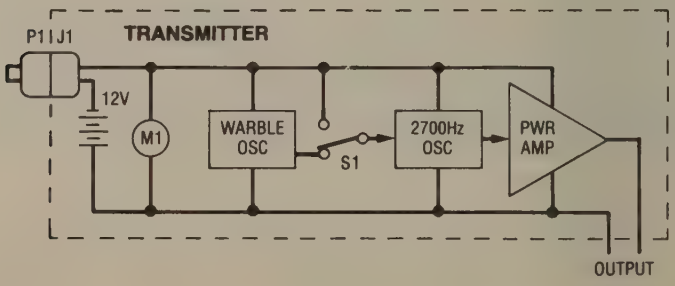


Figure 8. Transmitter Functional Block Diagram

3.03 Receiver — The Receiver (Figure 9) works in conjunction with the Tone Probe to receive the 2700Hz radiated by the cable and determines the cable direction. It is powered by a common 9-volt transistor radio battery. A pushbutton on/off switch connects the battery to the electronic circuitry and an expanded scale voltmeter circuit showing battery condition. The input circuitry consists of a high gain Amplifier and a probe Tuning Capacitor. The Tone Probe is tuned by the capacitor to 2700Hz, which helps the receiver to reject stray interference. After much amplification, the 2700Hz tone is coupled through a volume control to a tuned amplifier which provides additional gain at 2700Hz and additional interference rejection. The Tuned Amplifier output drives a Power Amplifier which raises the tone level enough to operate the loudspeaker.

3.04 The operation of the circuits used in the Cable Hound cable locator are discussed in the following paragraphs. Schematics are provided with DC operating voltages at various points. Numbers enclosed by the black hexagons key the schematic, part location, and gain/waveform material together to simplify testing.

3.10 Transmitter

3.11 Operation of the various Transmitter circuits (Figure 10) is discussed in the following paragraphs. The voltages and waveforms described are dependent upon battery voltage.

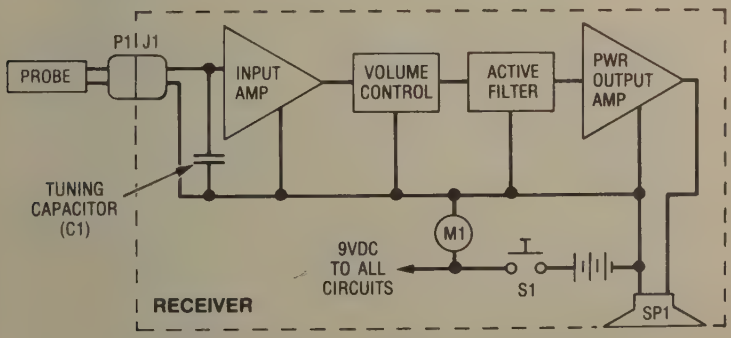


Figure 9. Receiver Functional Block Diagram

3.12 Power Circuitry — The Transmitter (Figure 10) obtains power from eight series-connected 1.5VDC "C" cells. The on/off switch function is provided by a shorted miniature phone plug P1 working in conjunction with a jack J1. The meter M1, resistor R9, and 6.8V zener CR4 function together to provide a battery test which gives a bad indication when the battery voltage is 8.5VDC or less (M1 is red-lined at 0.5 milliamperes).

3.13 Warble Oscillator — The Warble Oscillator switches the 2700Hz Oscillator on and off to produce an interrupted tone instead of a continuous tone. The oscillator consists of one-half of Z1 and the associated components R1, R2, R3, R4, and C1. When power is applied, the positive input of the amplifier is biased more positive than the negative input. The amplifier output immediately goes as far positive as its internal circuitry permits, applying about 10.5VDC across R3 (150K) into C1. The charge on C1 increases until the negative amplifier input is biased more positive than the positive input. When this happens, the amplifier output drops to about 1.5VDC, dropping the voltage on the positive amplifier input about 2VDC and reversing the current flow through R3. When the capacitor voltage again crosses the voltage on the positive input the amplifier output switches state again, repeating the cycle.

3.14 2700Hz Oscillator — The 2700Hz Oscillator consists of one-half of Z1, a tuned circuit T1 and C3, and the resistors and capacitors R5, R6, R7, C2, and C4. Mode switch S1 has two positions ST (steady tone) and WT (warble tone). These positions provide continuous voltage (12VDC battery) or pulsating voltage (output of the Warble Oscillator) to the 2700Hz Oscillator. Assume S1 is set to ST (steady tone). Bias voltage is conducted to the positive amplifier input by T1. The amplifier has its negative input connected to its output, causing no voltage gain. Some of the amplifier's output voltage is coupled into a tap on the coil of the tuned circuit. The voltage is stepped up by the transformer action of T1 and coupled to the positive input of the amplifier. Since the feedback signal and amplifier input voltage is in phase, oscillations result at the resonant frequency of T1 and C3. The

inductance of T1 can be varied slightly to set the frequency to exactly 2700Hz. When S1 is set to WT (warble tone) the oscillator switches on whenever the Warble Oscillator output waveform is positive.

3.15 Power Amplifier — Transistors Q1, Q2, and Q3 provide further amplification of the 2700Hz tone. The amplifier is not linear, and develops a square wave output voltage of approximately the same peak to peak voltage as the battery voltage. The zener CR1 offers protection to the transistors from excessive AC voltage being coupled from the cable being tested to ground through the unit. The transmitter output is coupled to the cable by a 2mfd capacitor. The capacitive reactance (30 ohms) limits the peak output current enough to prevent damage to the output transistors if the clip leads are shorted together momentarily.

3.20 Tone Probe

3.21 The Tone Probe (Figure 11) resonates with the 5620pf Receiver input capacitor C1 to 2700Hz. The 100K ohm resistor R13 provides loading to prevent excessive ringing, and provides bias current whenever the Tone Probe is unplugged.

3.30 Receiver

3.31 Power Circuitry — The Receiver Power Circuitry (Figure 11) consists of a 9-volt transistor radio battery, a pushbutton on/off switch, a metering circuit, voltage dividers, and decoupling circuitry. Voltage from the 9-volt battery passes through switch S1 to the amplifier circuitry. The voltage is sampled by the metering circuit, consisting of 5.6V zener CR3, 2210-ohm resistor R11, and a 0.5-milliampere meter movement M1. Voltage above the zener breakdown voltage develops a current across the 2210-ohm resistor and 800 ohms resistance of M1. M1 is a simple good/bad indicator which gives a bad indication if the battery voltage drops below 6.5VDC. Resistors R3 and R14 divide the battery voltage down to 4.5V to provide a reference voltage used to bias the amplifiers. C9, R1, and C2 provide decoupling for the bias. C4 lowers the AC impedance of the battery.

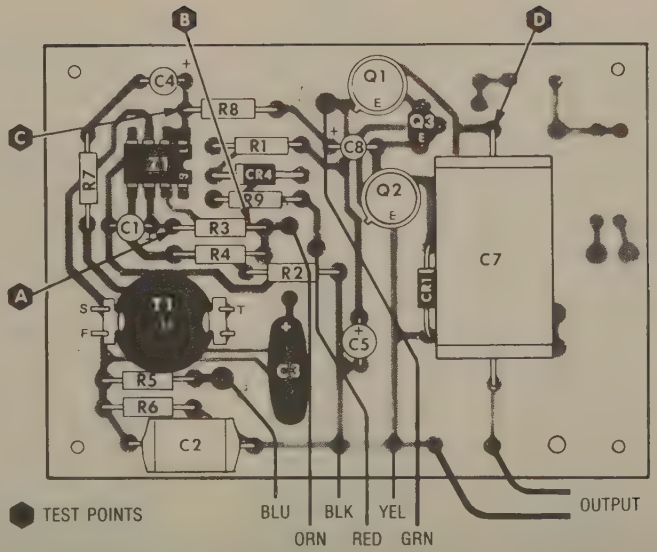


Figure 10. Transmitter Schematic (Sheet 1 of 2)

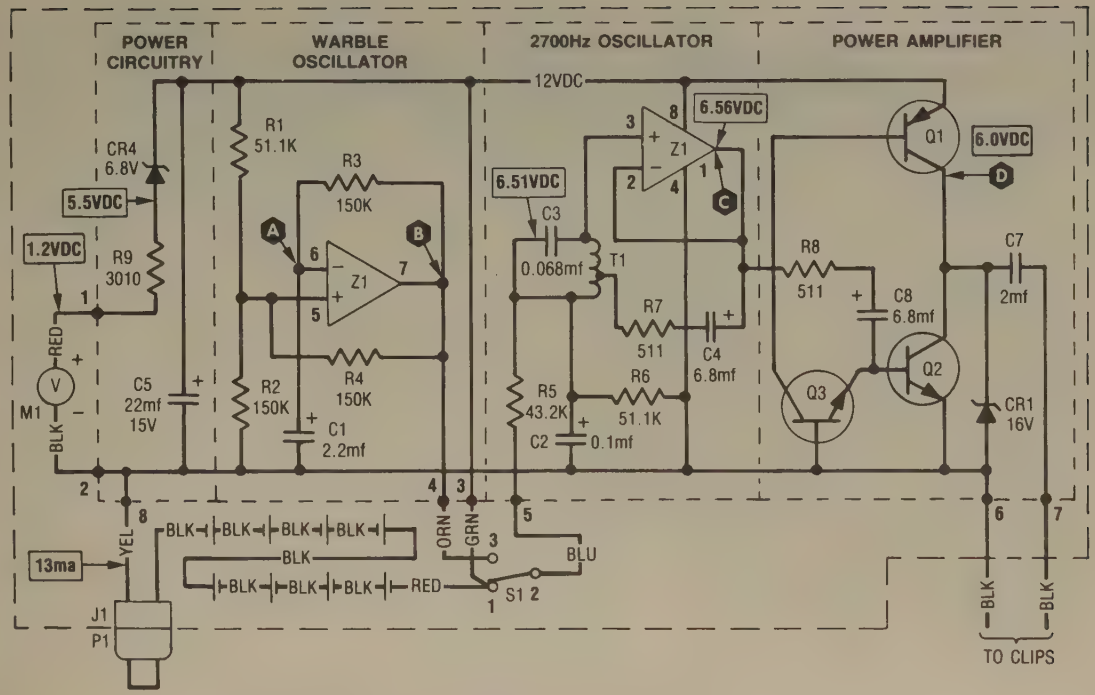


Figure 10. Transmitter Schematic (Sheet 2 of 2)

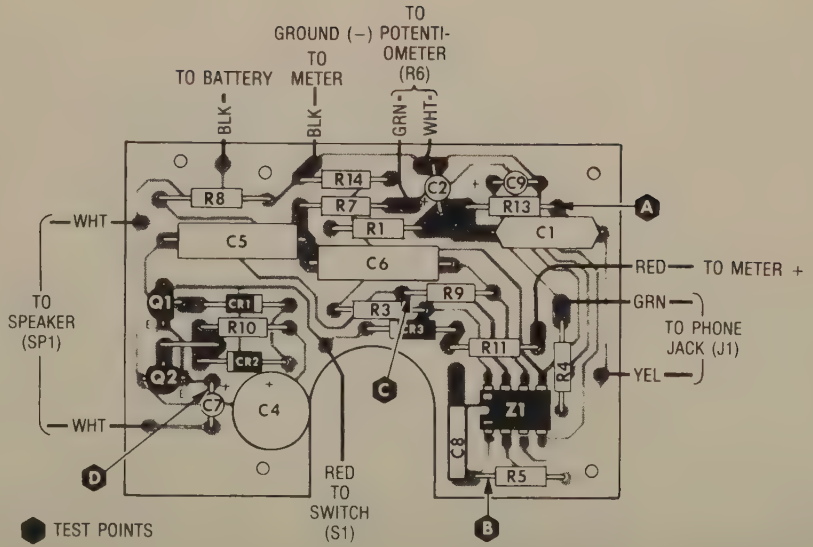


Figure 11. Tone Probe and Receiver Schematic (Sheet 1 of 2)

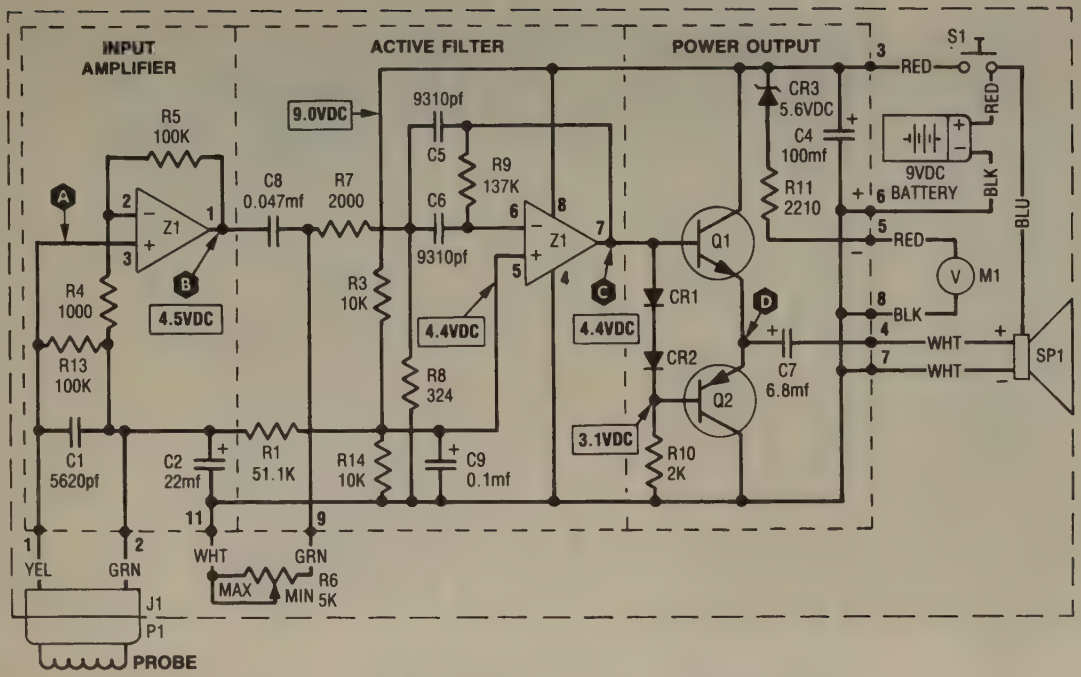


Figure 11. Tone Probe and Receiver Schematic (Sheet 2 of 2)

3.32 Input Amplifier — The Integrated Circuit Z1 (Figure 11) contains two separate high gain audio amplifiers. One of them is used as the input amplifier. The signal from the Tone Probe enters pin 3 of the Integrated Circuit. The amplifier's gain is determined by resistors R4 and R5, and is set to approximately 101X (40dB). The output signal is coupled to the Active Filter by C8, an 0.047mfd capacitor.

3.33 Active Filter — The second half of the integrated circuit and its associated components form an active band-pass circuit. Potentiometer R6 functions as a volume control by shorting some of the signal from C8 to ground. The reactance of C8 (about 1250 ohms) prevents excessive loading of the input amplifier. The components R7, R8, C5, C6, and R9 interact with the amplifier to produce a 2700Hz active bandpass filter. The output of this section is pin 7 of the integrated circuit. With the volume control in the maximum position, the gain from pin 1 to pin 7 of Z1 is approximately 15X (24dB) at 2700Hz.

3.34 Power Amplifier — The Active Filter output (Figure 11) drives the push-pull emitter follower Q1 and Q2 which provide current amplification without voltage amplification. Pin 7 of Z1 directly drives the base of Q1. The base of Q1 is coupled to the base of Q2 by two forward biased diodes, which also keep the transistors biased in the class "B" region. The forward bias on the diodes is maintained by the 2000-ohm resistor R10. The speaker is coupled to the Power Amplifier by a 6.8uf capacitor C7.

4. MAINTENANCE

4.01 Routine maintenance for the Transmitter and Receiver of the cable locator consists of periodic battery replacement. Alkaline batteries are recommended for minimum long term battery cost. Battery replacement procedure is given in the following paragraphs.

CAUTION: To prevent irreparable corrosion damage from battery leakage, remove batteries from unit if they are bad or if unit is stored for a period greater than 30 days.

4.02 Battery Replacement — Transmitter (Figure 12)

Step 1. Rotate two retaining tabs 90° to release Transmitter from Carrying Case.

Step 2. Remove Transmitter from case.

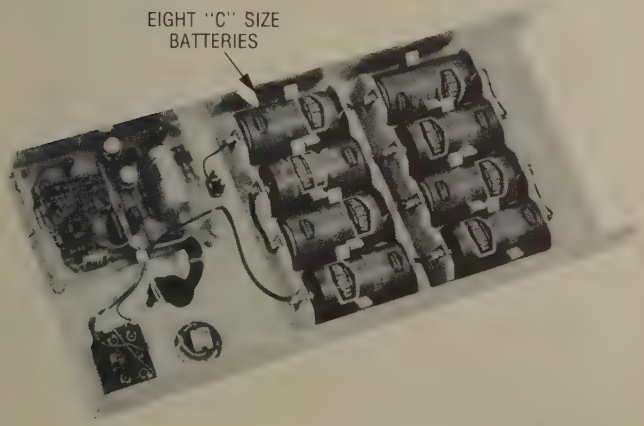


Figure 12. Battery Replacement — Transmitter

Step 3. Remove old batteries and replace with eight "C" size batteries with polarity as indicated on battery holder. Recommended replacement batteries are listed below.

Carbon-Zinc		Alkaline	
Burgess	No. 1	Eveready	No. E93
Eveready	No. 935	Mallory	No. SA14C or No. MN-1400
Ray-O-Vac	No. 1LD		

4.03 Battery Replacement — Receiver (Figure 13)

Step 1. Remove battery cover using small coin or screwdriver.

Step 2. Replace battery. Recommended replacement batteries are listed below.

Carbon-Zinc		Alkaline	
Eveready	No. 216	Eveready	No. 522
Burgess	No. 2U6	Mallory	No. MN-1604
Ray-O-Vac	No. 1604		

Step 3. Reposition cover.

4.04 If the Cable Hound fails to operate properly after battery replacement make a visible inspection of Transmitter wiring. If no breaks or corrosion are evident the unit may be returned to Metro Tel for service; see paragraph 4.05. If the unit is to be serviced locally see paragraph 5.

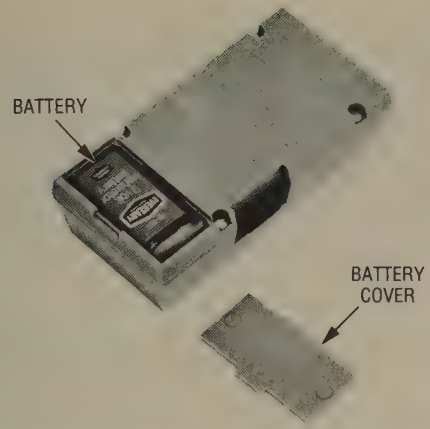


Figure 13. Battery Replacement — Receiver

4.05 Procedure for returning a defective unit is as follows:

Pack carefully and ship prepaid to:

Metro Tel Corp.

Manufacturing/Western Sales
250 S. Milpitas Boulevard
Milpitas, CA 95035
408-946-4600

5. SERVICE

5.01 If the cable locator does not function properly, a few simple checks will indicate which of the locator components is at fault. Always check the batteries powering the Transmitter and Receiver. If the Transmitter meter indicates low with new batteries installed, be sure the "C" cells are inserted properly and that all battery clips are clean and uncorroded. Assuming the Transmitter and Receiver batteries check good, examine the clip leads from the Transmitter for broken wires. The transmitter output can be checked by clipping the Transmitter to a butt-in or telephone set and listening for the tone. A terminating level meter will show about +16dBm/900 ohms. If the Transmitter seems to be working, skip the Transmitter service section and proceed directly to the Tone Probe and Receiver service sections.

5.10 Transmitter

5.11 Test Setup — The test setup illustrated in Figure 14 was used to obtain the information provided in this section. Table 1 lists the equipment recommended for testing the Transmitter. A regulated power supply is recommended instead of batteries to ensure measurements made on the Transmitter are not influenced by varying battery voltage.

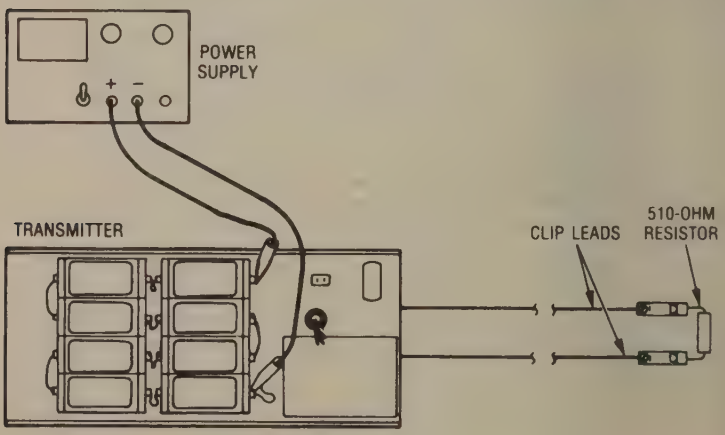


Figure 14. Transmitter Test Setup

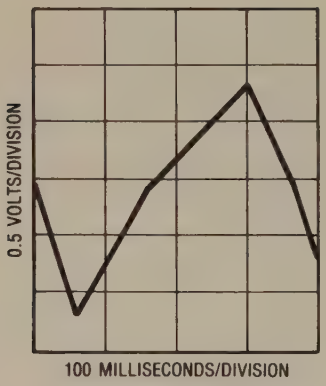
Table 1. Recommended Transmitter Test Equipment

Item	Required Characteristics
12VDC Power Supply	50-milliampere output current
DC Volt-Ohmmeter	20,000 ohms/volt DC sensitivity minimum
Oscilloscope	DC to audio frequency response
510-Ohm Resistor	±10% or better 1/4 or 1/2 watt

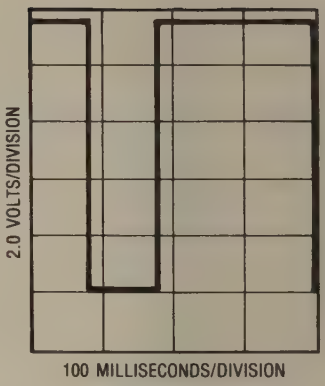
5.12 The exact waveforms and voltages given in this section are dependent upon an exact 12VDC battery voltage. New batteries may provide over 12VDC which will cause the levels to be slightly different. Table 2 shows some solutions to the more common Transmitter problems found in units received for repair by our Customer Service Department. Waveforms encountered in the Transmitter are shown in Figure 15. The Transmitter tests points where DC voltages and waveforms appear are identified in the Transmitter Schematic (Figure 10).

Table 2. Suggested Check-Points for Malfunctioning Transmitters

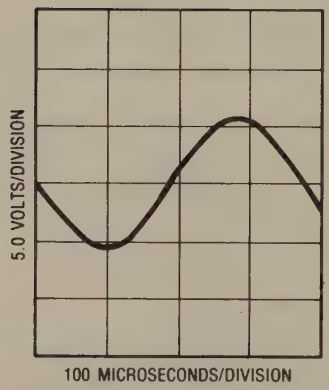
Problem	Possible Cause
Will not switch on	Corroded battery clips. Corroded plug or jack in power switch.
Meter indicates good battery, but no output	Broken clip leads. Bad SN72558P integrated circuit. Q1 or Q2 faulty.
Steady tone, but no warble tone	Bad switch S1. Bad SN72558P integrated circuit.
Metering circuit does not work	Bad meter movement, usually caused by excessive moisture in case.



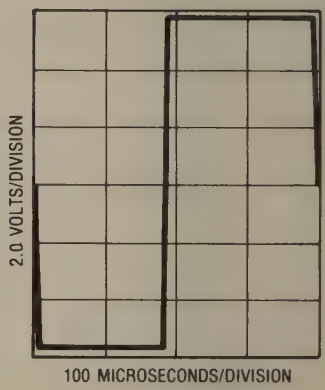
POINT Ⓐ
WARBLE OSCILLATOR



POINT Ⓑ
WARBLE OSCILLATOR



POINT Ⓒ
2700Hz OSCILLATOR



POINT Ⓓ
POWER AMPLIFIER

NOTE:
Transmitter test points are identified in Figure 10.

Figure 15. Transmitter Waveforms

5.20 Tone Probe

5.21 Test Setup — The test setup used to obtain the information provided in this section is shown in Figure 16. The test equipment recommended for testing the probe is given in Table 3. A measured amount of variable frequency tone is coupled into the probe by the two-turn link to permit output level measurements. The inductance of the probe (536 to 721 millihenries) is resonated to approximately 2700Hz by the 5600pf capacitor. The 100K ohm resistor loads the

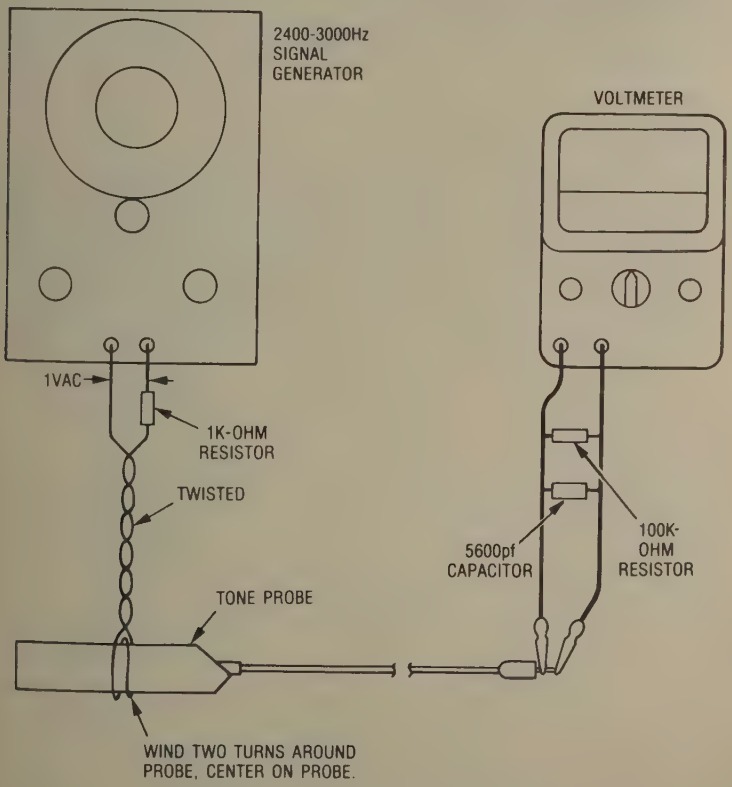


Figure 16. Tone Probe Test Setup

Table 3. Recommended Equipment to Test Tone Probe

Item	Required Characteristics
Signal Generator	1vrms output between 2400 and 3000Hz
1K-Ohm Resistor	1% preferred, 5% minimum; 1/4 watt
5600pf Capacitor	±5%, 100VDC minimum
Volt-Ohm-Milliammeter	Capable of measuring 50 ohms
AC Voltmeter	0-100mv scale, 1-10 megohms input impedance
100K-Ohm Resistor	±5% or better 1/4 watt

probe to reduce the "Q" (sharpness of tuning) of the probe/capacitor combination.

5.22 The Tone Probe is a ferrite rod wound with several thousand turns of wire. The two most probable causes of probe failure are open wiring and broken ferrite. Broken wire can be readily detected by an ohmmeter check, which should indicate about 50 ohms. Broken ferrite is detected by measuring the frequency response and output level of

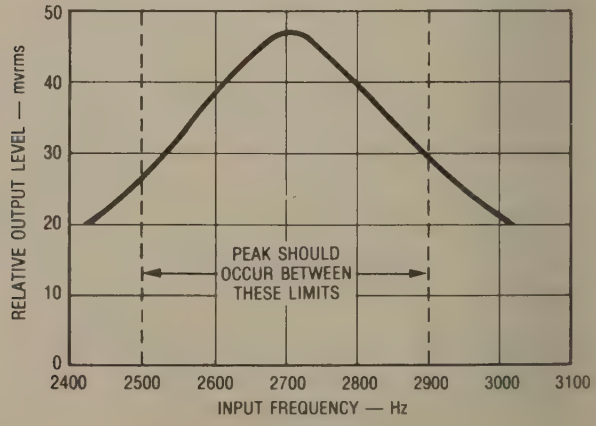


Figure 17. Tone Probe Response Curve

the probe. The correct Tone Probe response curve is given in Figure 17. If the shape of the response curve of the probe under test approximates Figure 17, and the 2700Hz output level is not lower than 22mvrms, the probe is satisfactory.

5.30 Receiver

5.31 Test Setup — The test setup used to obtain the information provided in this section is shown in Figure 18. Recommended test equipment is listed in Table 4. A fresh battery can be used in place of the 9V Regulated Power Supply, but the exact DC voltages on the schematic (Figure 11) assume an accurate 9VDC across the battery terminals.

5.32 Table 5 shows some of the more common problems encountered in Receivers received for repair by our Customer Service Department. The frequency response and gain characteristics of the Receiver provide assurance of proper functioning. Figure 19 shows the frequency response characteristics of the Receiver from point A to point C . The test points are identified on the Receiver Schematic (Figure 11). Table 6 shows the 2700Hz amplification of the Receiver between various test points. Gain and response characteristics similar to that in Figure 19 and Table 6 assure proper Receiver functioning.

Table 4. Recommended Receiver Test Equipment

Item	Required Characteristics
Signal Generator	1vrms output between 2400 and 3000Hz
Repeat Coil (Audio Isolation Transformer)	Good audio frequency isolation between primary and secondary. Ability to pass 2300 to 2900Hz with little variation in amplitude
100-Ohm and 200K-Ohm Resistors	1% preferred. 5% carbon composition or carbon film acceptable
9VDC Regulated Power Supply	200-milliampere output current
AC Voltmeter	Capable of measuring from 50mvrms to 1vrms
Plug Matching Receiver's Tone Probe Jack	Switchcraft® 750, 755, or equivalent

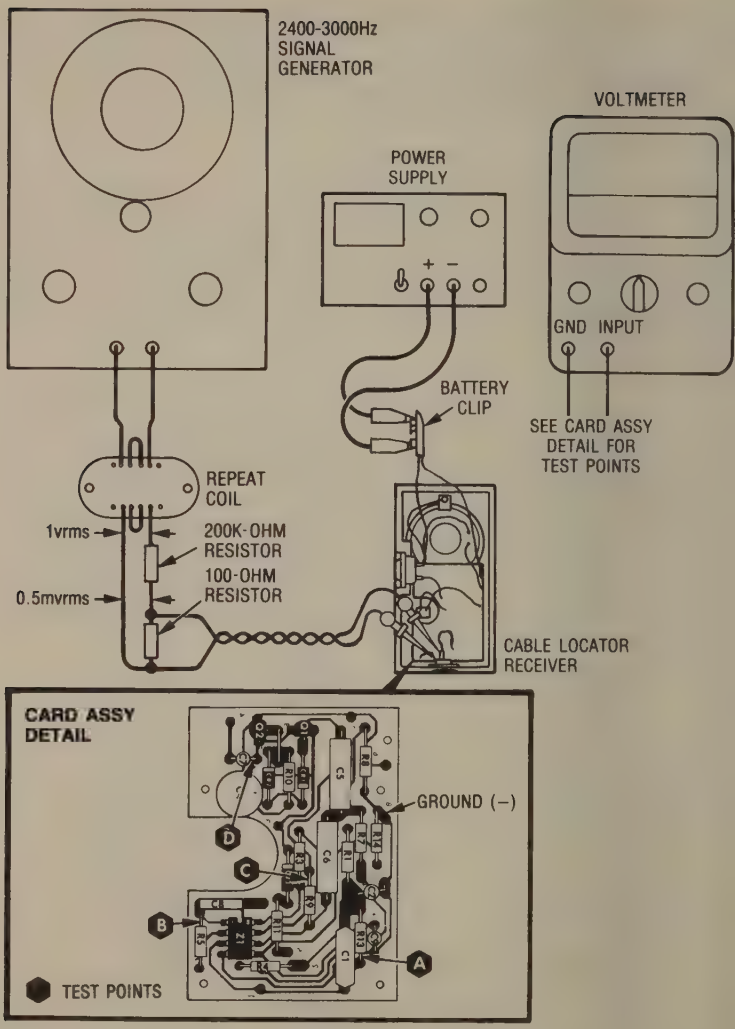


Figure 18. Receiver Test Setup

Table 5. Suggested Check-Points for Malfunctioning Receivers

Problem	Possible Cause
Nothing works	Bad battery. Broken battery lead.
Meter indicates good but no output or weak output	Broken Tone Probe or probe wire. Bad speaker (open voice coil — no output; warped cone — weak or distorted output). Bad integrated circuit. One or more bad transistors.
Oscillations (squealing)	Ground wire (blue) to speaker frame broken, lug connecting wire to speaker corroded. Decoupling capacitor (C2, C4, or C9) broken loose from printed circuitry.

Table 6. Receiver Gain and Level Measurements at 2700Hz

Test Points*	Gain	Output Level
Ⓐ to Ⓑ	101X, 40dB	50.5mvrms
Ⓑ to Ⓒ	15X, 24dB	700mvrms
Ⓒ to Ⓓ	0	700mvrms

*Test points are identified on the Receiver Schematic (Figure 11).

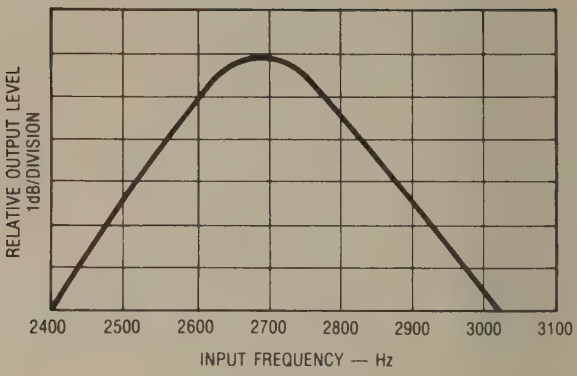


Figure 19. Receiver Frequency Response Curve

6. REPLACEABLE PARTS

6.01 The tables in this section list the figure index numbers, part numbers, description, and reference designators for each part making up the Cable Hound cable locator. Table 7 lists the major cable locator components, Tables 8 and 9 list the Receiver replaceable parts, and Tables 10 and 11 list the Transmitter replaceable parts. Items listed without index numbers are not illustrated. The parts lists are keyed with reference designators that correspond to reference designators shown in Figures 21 and 23 (Card Assembly Parts List) and Figures 10 and 11 (Schematics).

6.03 Metro Tel, to obtain manufacturing uniformity, may use components of greater precision than actually required for proper circuit operation. However, if parts other than those specified in the parts lists are used in the repair of the cable locator, the proper operation should be confirmed by the test procedures in this manual before actual field usage.

6.04 Order Information — Many of the parts used in the Cable Hound cable locator are available commercially. Parts not available from a local dealer can be ordered directly from Metro Tel. Part numbers are given in the parts lists. Contact out Customer Service Department for ordering assistance.

Table 7. Cable Locator Parts List

Description	Metro Tel Number	Former Number	Quantity Required
Case, Plastic Carrying	60-0004	72-40-027	1
Case, Wood Carrying	55-0001	72-40-031	1
Label, Operating Instructions	52-0006	73-04-740	1
Manual, Operating and Service	56-0005	73-10-092	1
Probe, Tone	99-0119	78-01-375	1
Receiver	99-0122	78-01-801	1
Rod, Ground	53-0001	73-72-980	1
Transmitter, Plastic Case	99-0121	78-01-802	1
Transmitter, Wood Case	99-0120	78-01-800	1

Table 8. Receiver Parts List

Description	Metro Tel Number	Former Number	Qty.	Illus. (Fig. 20)	Schem.
Clamp, Speaker	90-0024	72-40-335	2	12	—
Clip, Dual Battery	90-0027	72-40-570	1	9	—
Cloth, Speaker, Receiver	66-0001	72-40-800	1	14	—
Housing, Receiver	60-0003	72-87-505	1	2	—
Insulator	52-0005	72-92-947	1	3	—
Insulator	52-0010	72-92-948	1	10	—
Jack, Miniature Phone w/Hardware	90-0029	72-99-250	1	5	J1
Lug, Solder, Screw Mount	90-0031	73-07-480	1	11	—
Meter, 0.5 Milliampere	90-0032	73-10-475	1	16	M1
Potentiometer w/hex nuts	94-0008	73-20-258	1	15	R6
Screw, No. 4 x .375" Self Tap	17-0002	73-76-853	4	1	—
Screw, No. 4 x .270" Self Tap	17-0001	73-76-851	3	6	—
Speaker, 8-ohm, 0.2W, 2" Dia.	90-0036	73-79-255	1	13	SP1
Switch, SPST Push Button	90-0038	73-79-860	1	4	SW1
Tie, Cable	90-0023	72-08-120	1	8	—

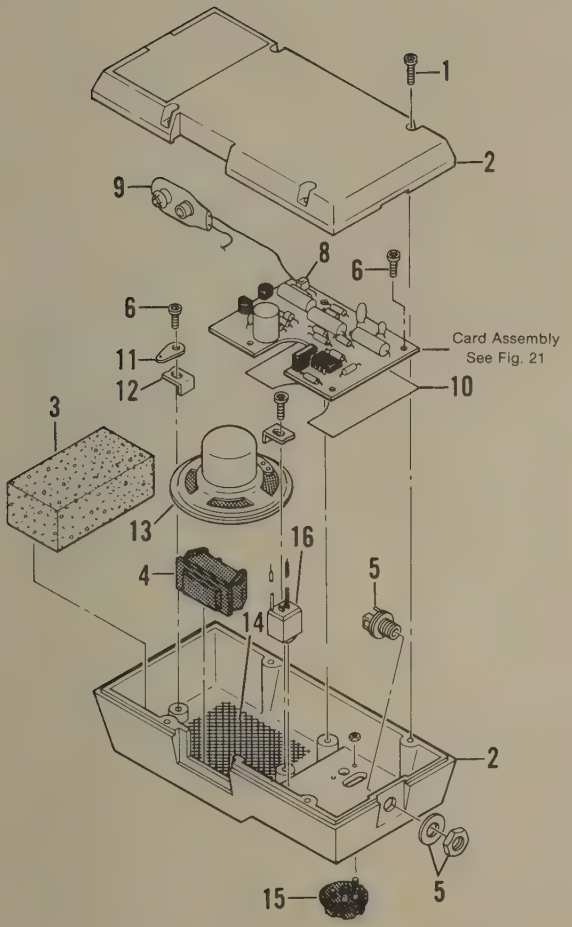


Figure 20. Receiver Illustrated Parts Breakdown

Table 9. Receiver Card Assembly Parts List

Description	Metro Tel Number	Former Number	Qty	Illus. (Fig. 21)	Schem.
Board, Printed Circuit	52-0008	73-17-156	1	21	—
Capacitor, 5620pf, 160V, 2.5%	92-0020	72-16-232	1	1	C1
Capacitor, 22mfd, 15V, 20%	92-0026	72-25-635	1	2	C2
Capacitor, 100 mfd, 25V, -10 +75%	92-0066	72-34-759	1	3	C4
Capacitor, 9310pf, 100V, 1%	92-0019	72-15-385	2	4	C5, C6
Capacitor, 6.8uf, 35V, 20%	92-0025	72-25-581	1	5	C7
Capacitor, .047uf, 100V, 20%	92-0022	72-18-123	1	6	C8
Capacitor, 0.1uf, 35V, 20%	92-0023	72-25-570	1	7	C9
Diode, IN4004	94-0004	72-60-250	2	8	CR1,CR2
Diode, 5.6V Zener, .5W, 5%	94-0005	72-61-506	1	9	CR3
Integrated Circuit, Dual Amp SN72558P	96-0003	72-95-003	1	20	Z1
Resistor, 51.1K ohm, 1/4W, 1%	93-0028	73-52-303	1	12	R1
Resistor, 10K ohm, 1/4W, 1%	93-0026	73-48-035	2	13	R3, R14
Resistor, 1000 ohm, 1/4W, 1%	93-0022	73-35-995	1	14	R4
Resistor, 100K ohm, 1/4W, 1%	93-0029	73-54-050	2	15	R5, R13
Resistor, 2000 ohm, 1/4W, 1%	93-0023	73-39-497	2	16	R7, R10
Resistor, 324 ohm, 1/2W, 1%	93-0205	73-29-396	1	17	R8
Resistor, 137K ohm, 1/4W, 1%	93-0030	73-54-898	1	18	R9
Resistor, 2210 ohm, 1/4W, 1%	93-0024	73-40-010	1	19	R11
Transistor, NPN, 2N3567	95-0008	74-00-510	1	10	Q1
Transistor, PNP, 2N3638A	95-0010	74-01-510	1	11	Q2

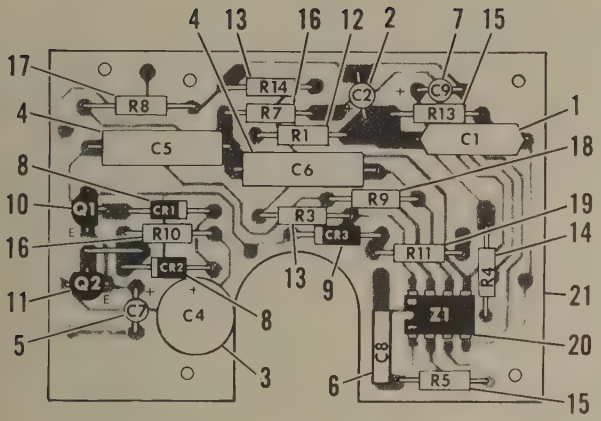


Figure 21. Receiver Card Assembly

Table 10. Transmitter Parts List

Description	Metro Tel Number	Former Number	Qty	Illus. (Fig. 22)	Schem.
Bracket, Receiver Retaining for Wood Case	50-0001	72-06-926	1	—	—
Bracket, Z Mounting	90-0022	72-07-110	1	6	—
Chassis	50-0002	72-06-927	1	17	—
Clip, Alligator	90-0026	72-40-350	2	2	—
Eyelet	40-0001	72-71-604	8	15	—
Grommet 9/32" x 9/16"	67-0003	72-80-010	1	3	—
Holder, Battery, "C" Cell	90-0028	72-85-600	8	16	—
Jack, Miniature Phone w/Hardware	90-0029	72-99-250	1	8	J1
Meter, 0.5 Milliampere	90-0032	73-10-475	1	7	M1
Nut, No. 4-40 Self Locking	21-0001	72-12-801	4	13	—
Plug, Miniature Phone	90-0035	73-19-900	1	1	P1
Screw, No. 4-40 x 0.625 Pan Head	16-0001	73-74-195	4	11	—
Screw, No. 6-32 x 0.25" Binding Head	16-0002	73-74-204	1	5	—
Spacer No. 4 x 0.25", Fiber	52-0009	73-78-890	4	12	—
Switch, SPDT Toggle	90-0037	73-79-820	1	4	SW1
Tie, Cable	90-0023	72-08-120	1	10	—
Washer, Fiber Shoulder	33-0003	72-24-000	1	9	—

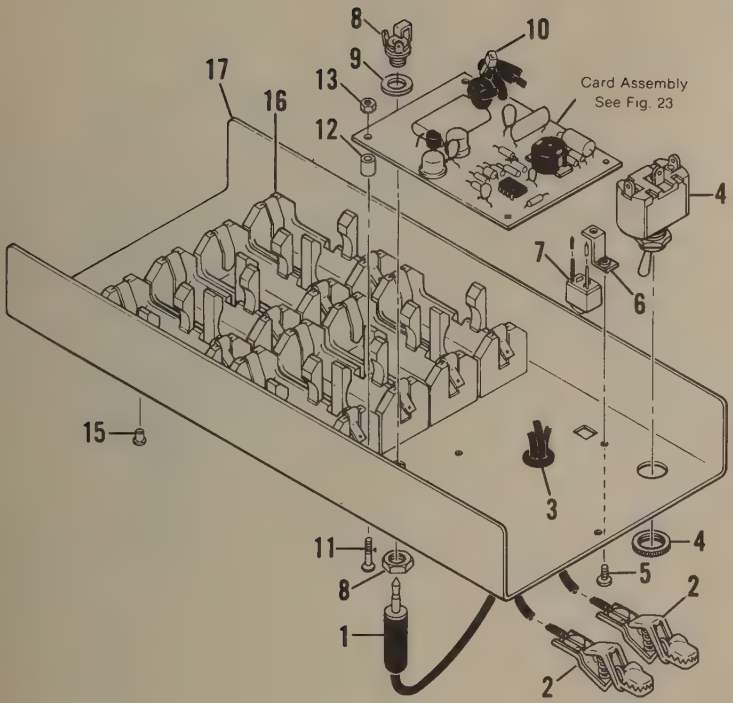


Figure 22. Transmitter Illustrated Parts Breakdown

Table 11. Transmitter Card Assembly Parts List

Description	Metro Tel Number	Former Number	Qty	Illus. (Fig. 23)	Schem.
Board, Printed Circuit	52-0007	73-17-155	1	21	—
Capacitor, 2.2uf, 35V, 20%, Tantalum	92-0024	72-25-578	1	1	C1
Capacitor, 0.1uf, 250V, 20%, Mylar	92-0027	72-30-460	1	2	C2
Capacitor, 0.068uf, 100V, 5% Mylar	92-0021	72-30-000	1	3	C3
Capacitor, 6.8uf, 35V, 20%, Tantalum	92-0025	72-25-581	2	4, 7	C4, C8
Capacitor, 22uf, 15V, 20%, Tantalum	92-0026	72-25-635	1	5	C5
Capacitor, 2uf, 250V, 10%, Mylar	92-0028	72-32-961	1	6	C7
Diode, Zener, 16V, 1W, 5%	94-0007	72-61-870	1	8	CR1
Diode, Zener 6.8V, 1/2W, 5%	94-0006	72-61-790	1	9	CR4
Integrated Circuit, Dual Amp, SN72558P	96-0003	72-95-003	1	20	Z1
Pad, Transistor	90-0033	73-16-250	2	12	—
Resistor, 51K ohm, 1/4W, 1%	93-0028	72-52-303	2	14	R1, R6
Resistor, 150K ohm, 1/4W, 1%	93-0031	73-54-999	3	15	R2,R3,R4
Resistor, 43.2K ohm, 1/4W, 1%	93-0027	73-51-759	1	16	R5
Resistor, 511 ohm, 1/4W, 1%	93-0032	73-31-415	2	17	R7, R8
Resistor, 3010 ohm, 1/4W, 1%	93-0025	73-41-510	1	18	R9
Transformer	99-0123	79-70-914	1	19	T1
Transistor, 2N2905A	95-0009	74-00-235	1	10	Q1
Transistor, 2N4401	95-0012	74-01-795	1	11	Q2
Transistor, 2N5210	95-0011	74-01-772	1	13	Q3

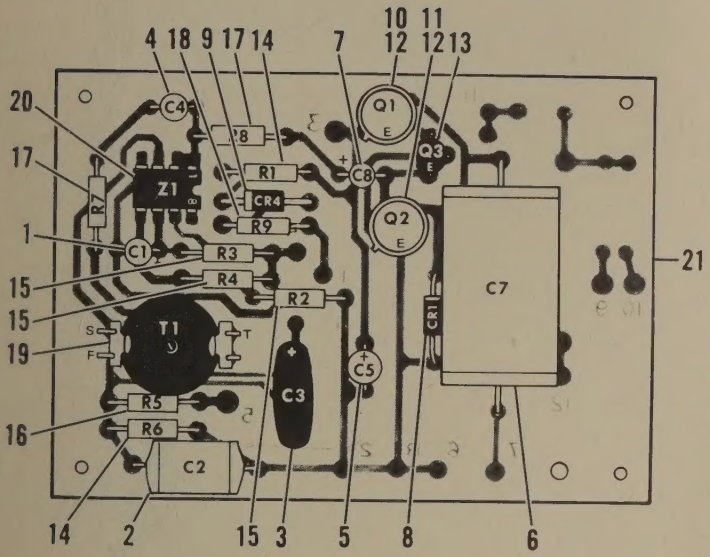
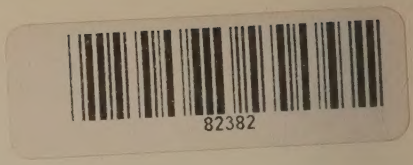


Figure 23. Transmitter Card Assembly



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